RID: 16th Session of the RID Committee of Experts’ working group on tank and vehicle technology (Krakow, 19 and 20 November 2018)

Subject: Risk assessment of extra-large tank-containers

Information from CEFIC
CHANCE
RISK-ASSESSMENT
RID Committee of Experts
CHANCE – An integrated solution of innovations…

- Fully automated Tank-Container Terminal (TCL)
- BASF Class Tank Container (B-TC) with payload up to 66 tons
- Container carrying wagons for B-TCs
- Automated Guided Vehicle (AGV) for internal transports
- Transponders on roads across plant and BASF-Wireless-Network
...to optimize the rail & site logistics

Conventional rail transport

Today
22 hours

Intermodal transport Rail & Road

Future
1 hour
## CHANCE – Fully automated Tank-Container Terminal (TCL)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity [TEU]</td>
<td>2,000</td>
</tr>
<tr>
<td>Container Stacking</td>
<td>6 (1+5)</td>
</tr>
<tr>
<td>Portal crane</td>
<td>2</td>
</tr>
<tr>
<td>Tracks under crane</td>
<td>3</td>
</tr>
<tr>
<td>Truck/AGV docking station</td>
<td>8</td>
</tr>
<tr>
<td>Operational since</td>
<td>7/2018</td>
</tr>
</tbody>
</table>
CHANCE – Automated Guided Vehicle (AGV)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomous driving mode</td>
<td>Transponders &amp; Sensors</td>
</tr>
<tr>
<td>Tele-operation</td>
<td>Transponders, Sensors &amp; Control-Center</td>
</tr>
<tr>
<td>Lenght AGV</td>
<td>16.5 m</td>
</tr>
<tr>
<td>Payload AGV</td>
<td>78 Tonnen</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 3cm</td>
</tr>
<tr>
<td>Number / transport volume</td>
<td>8 / 1 million tons per year</td>
</tr>
</tbody>
</table>
**CHANCE – innovative container carrying wagon (iCTW)**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lenght</td>
<td>15.15 m (45’) – 17 m (52’)</td>
</tr>
<tr>
<td>Noise</td>
<td>78 dB (45’) &amp; 80 dB (52’)</td>
</tr>
<tr>
<td>Dead weight / payload</td>
<td>16.5 t / 73.5 t</td>
</tr>
<tr>
<td>Count</td>
<td>342 till mid 2019</td>
</tr>
<tr>
<td>Possible Shunting yard</td>
<td>78 dB (45’) &amp; 80 dB (52’)</td>
</tr>
</tbody>
</table>

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11.11.2018
CHANCE – innovative container carrying wagon (iCTW)

C-Buffers (150 mm)

reinforced spigots (2g)

disk brakes (45')
## CHANCE – Technical Changes iCTW

<table>
<thead>
<tr>
<th>Component</th>
<th>Change</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Innovative Container-Carrying-Wagon (iCTW)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spigot</td>
<td>reinforced, stronger materials</td>
<td>optimised for higher load</td>
</tr>
<tr>
<td>Buffer</td>
<td>Long-Stroke-Buffer (C-Buffer) 150 mm instead of 105 mm</td>
<td>Shunting-yard capability</td>
</tr>
<tr>
<td>Wagon-Frame</td>
<td>material, geometry</td>
<td>5-L, optimised for B-TC</td>
</tr>
<tr>
<td>Brakes</td>
<td>45’ – Disk-brakes 52’ – CFCB</td>
<td>Noise-reduction &amp; Life-Cycle</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHANCE – innovative Container Carrying Wagon (iCTW) Approval & Facts

iCTW | Count in total 342
---|---
In traffic | 202
Ordered | 140 more in manufacturing process
CHANCE – BASF Class Tank-Container (B-TC)

- Length: 45’ & 52’
- Volume: 53 – 73 m³
- Weight: ~ 8 t
- Stacking: 6
CHANCE – BASF Class Tank-Container (B-TC)

reinforced corner-castings

reinforcement rings under cladding

T-Pipe bottom discharge

Outlet protection frame
### CHANCE – Facts & Figures
BASF Class Tank-Container

<table>
<thead>
<tr>
<th>B-TC</th>
<th>Count in total 950</th>
</tr>
</thead>
<tbody>
<tr>
<td>In traffic</td>
<td>350</td>
</tr>
<tr>
<td>Ordered</td>
<td>600 more already in manufacturing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specification</th>
<th>L4BH</th>
<th>L4BH</th>
<th>L4BH</th>
<th>L4DH</th>
<th>L10BH</th>
<th>L10DH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>standard</td>
<td>standard</td>
<td>specialized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length [ft]</td>
<td>45</td>
<td>45</td>
<td>52</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Volume [l]</td>
<td>63.000</td>
<td>53.500</td>
<td>73.000</td>
<td>62.000</td>
<td>63.000</td>
<td>62.000</td>
</tr>
<tr>
<td>Heating</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Insulation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lining</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
In January 2018 BASF agreed to conduct a Risk-Assessment according to CSM – VO (EU) 402/2013. BASF Class tank-containers are certified and approved since June 2015 for the transport of dangerous goods and since June 2015 in use without incidents. Based on the results BASF intends to propose adjustment suggestions to the current regulations of the conventional and intermodal transport.
Scope of the Risk-Assessment

Comparison of the new equipment vs. conventional & intermodal equipment

- B-TC & iCTW
- Tank container & CTW
- Tank car

Comparison of:
- driving behavior
- system limits
- surging movements
- technical specifications

Comparison by:
- driving trails
- simulations
- impact-tests
- data analysis
Organization Risk-Assessment

- Coordination & Realization (BASF)
  - Equipment (BASF)
  - Process Responsibility (BASF)
  - Longterm Trails (BASF, EVU)
  - Functional Trails (BTC Wustermark)
  - Simulation & Analysis (TU Berlin)
  - Documentation (BASF, TU Berlin)
  - Communication (BASF)

- Manufacturers (Van Hool, Wascosa, Tatravagonka)

- Support (Technische Universität Berlin)

- Sounding Board (BMVI, EBA, BAM, UIP, BASF, UIRR...)

- ECM & EVU (BASF)

- Transport Safety (BASF)

Assessment Body (Bureau Veritas France)
Support for technical analysis, trails, impact-tests, simulations & documentation

Faculty Mechanical Engineering and Transport Systems
Institute of Land and Sea Transportation Systems
Department of Rail Vehicles, Prof. Dr.-Ing. M. Hecht

Research: vehicle dynamics, safety, acoustics, telematics, etc.

Services:
• MKS-Simulations
• FE-Models & Analysis
• driving behavior data collection & analysis
• safety assessment
Risk-Assessment – Bureau Veritas

Independent assessment body

Bureau Veritas Exploitation France
Rail Operations
Ms. B. Scaglione

Services:
• Third-party assessment (notified body)
• Technical and safety assistance
• Conformity of Assessment
• Certification (ECM, IRIS)
Risk-Assessment Prozess

Risk-Assessment according to CSM – VO (EU) 402/2013

- a) Significance assessment
- b) Risk-Management Process
- c) System definition
- d) Risk-Analysis
- e) Risk-Evaluation
- f) Independent Assessment
- g) Conclusion
Work packages Risk-Assessment

**WP 1**
Comparison and Assessment of the innovative Intermodal System (B-TC & iCTW)
- Based on technical documentation

**WP 2**
Experimental trails
- Different loadings
- Data collection of forces and accelerations

**WP 3**
Modelling and simulation of the driving behaviour
- Simulation of system limits
- Based on collected and technical data

**WP 4**
FE-modelling and analysis
- Simulation between different systems
- Detection of particular stressed positions

**WP 5**
Impact-Tests
- Overriding Impact-Test of different equipment
- Voluntarily and additionally to CSM requirements

**WP 6**
Longterm trails for data collection in different driving situations
- 3D-acceleration data
- Voluntarily and additionally to CSM requirements
Work package 1 – Paper based technical comparison

Comparison of:
• used material
  • material specification
  • material strength
  • etc.
• technical specification
  • payload
  • gross weight, etc.
for the different system

Objectives:
• System definition
• Risk-Analysis & Detection
• Risk-Evaluation
Work package 2 – Experimental examinations of the driving behaviour

- S-Curve ride
- Loading: 100 %, 50 % & 0 %
- Data gathering: Forces / Acceleration
  - Data-base for simulations
- Comparison of the driving behaviour
Work package 3 – Modelling and simulation of the driving behaviour

• Assessment of vehicle dynamics
• Comparison of different systems
• Simulation via SIMPACK
• Different simulation scenarios with increasing velocity till failure
  • S-Curve
  • Curve with cant and distortion
  • Crash
  • Specific Topology
• Analysis of Simulation results
Work package 4 – FE-Modelling and Analysis of Crash-Scenarios

- FE-Modelling of crash scenarios between different systems
- Scenario: Overriding with different velocities
- Analysis and evaluation of occurring forces & damages
Work package 5 – Impact-Tests

- Impact-Scenario Overbuffering / Overriding
- Experimental assembly based on simulation results (tbd.)
- Comparison of the damage pattern between compared systems
- Analysis of damages

*Voluntarily and additionally to CSM requirements*
Work package 6 – Longterm Trails

- Data collection of accelerations at B-TC & iCTW in realistic cases
- Analysis of critical impacts
- Analysis of acceleration differences between B-TC & iCTW

*Voluntarily and additionally to CSM requirements*
Risk-Assessment schedule

WP 1 – Paper based comparison
WP 2 - trials
WP 3 – Simu.
WP 4 – FE
WP 5 Impact Test
WP 6 – long-term trials

Analysis, evaluation & report (TUB)

Documentation BASF
Independent Assessment BV

Krakau 11/18
2018 - 2019
Interim results
Final Report 30.07.19
Risk-Assessment – expected results

Risk-Evaluation of different systems

- Repercussions of the technical changes
- Scientific comparison between new, conventional and intermodal systems

Suggestions for existing regulations

- Tank Construction (e.g. different wall-thickness for the three investigated systems)
- 20t load for disc brakes
- Labelling for handling of new system (crane & spigots)
- Additional safety measures for a few chemicals (e.g. increased distance between tank and buffers)
- Minimum filling degree in rail transport (80/20 regulation for tank containers)